National Transportation Safety Board

Human Performance Issues

Maintenance Errors

- Improper securing of the fore/aft servo
- Improper tension of the hydraulic belt
- Incomplete maintenance inspection

Overview

- Maintenance personnel fatigue
- Human factors training for maintenance personnel
- Work cards with delineated steps

Maintenance Personnel Fatigue

- The mechanic
  - Recent sleep and wake activity
    - Earlier bedtime than normal but had difficulty falling asleep
  - Shift change
    - 6 hours earlier than normally scheduled shift
  - Inadequate sleep
    - 5 hours of sleep the night before

Maintenance Personnel Fatigue

- The inspector
  - Recent sleep and wake activity
    - 7 hours of sleep the night before
  - Shift change
    - Over 6 hours earlier than normally scheduled shift
  - Long duty day
    - Over 14 hours

Maintenance Personnel Fatigue

Personnel	Normal Shift	Actual Shift on December 6	Duty Length	Time Awake
Mechanic	Noon to 11:00 pm	5:50 am to 6:46 pm	12:56	13:46
Inspector	Noon to 11:00 pm	5:31 am to 6:55 pm	13:24	14:55

Maintenance Personnel Fatigue

- Effects of fatigue
  - Difficulty sustaining attention
  - Memory errors
  - Lapses in performance

Duty-Time Regulations

- ValuJet Airlines accident (1996)
- Establishing duty-time limitations based on the following:
  - Start time
  - Workload
  - Shift changes
  - Circadian rhythms
  - Adequate rest time

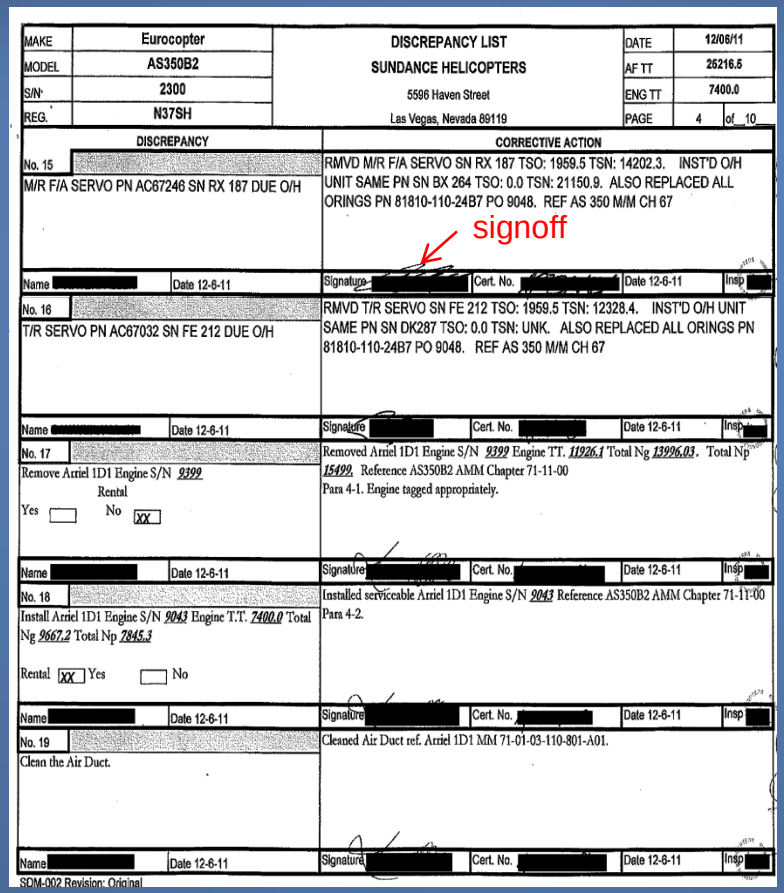
Human Factors Training

- Causes of fatigue, its effects, and countermeasures
- Fatigue education as part of a training curriculum
- No human factors training requirement in United States

Work Cards With Delineated Steps

- Paperwork for 100-hour inspection
- Inspector signoff for overall fore/aft servo installation
- No specific signoffs for critical steps within task

100-Hour Inspection Paperwork



MAKE	Eurocopter	DISCREPANCY LIST	DATE	12/06/11
MODEL	AS350B2	SUNDANCE HELICOPTERS	AF TT	26216.5
S/N	2300	5596 Haven Street	ENG TT	7400.0
REG.	N37SH	Las Vegas, Nevada 89119	PAGE	4 of 10

DISCREPANCY	CORRECTIVE ACTION
No. 15 M/R F/A SERVO PN AC67246 SN RX 187 DUE O/H	RMVD M/R F/A SERVO SN RX 187 TSO: 1959.5 TSN: 14202.3. INST'D O/H UNIT SAME PN SN BX 264 TSO: 0.0 TSN: 21150.9. ALSO REPLACED ALL ORINGS PN 81810-110-24B7 PO 9048. REF AS 350 M/M CH 67 signoff Name [redacted] Date 12-6-11 Signature [redacted] Cert. No. [redacted] Date 12-6-11 Insp [redacted]
No. 16 T/R SERVO PN AC67032 SN FE 212 DUE O/H	RMVD T/R SERVO SN FE 212 TSO: 1959.5 TSN: 12328.4. INST'D O/H UNIT SAME PN SN DK287 TSO: 0.0 TSN: UNK. ALSO REPLACED ALL ORINGS PN 81810-110-24B7 PO 9048. REF AS 350 M/M CH 67 Name [redacted] Date 12-6-11 Signature [redacted] Cert. No. [redacted] Date 12-6-11 Insp [redacted]
No. 17 Remove Arriel 1D1 Engine S/N *9399* Rental Yes ☐ No XX	Removed Arriel 1D1 Engine S/N *9399* Engine TT. *11926.1* Total Ng *13996.03*. Total Np *15499*. Reference AS350B2 AMM Chapter 71-11-00 Para 4-1. Engine tagged appropriately. Name [redacted] Date 12-6-11 Signature [redacted] Cert. No. [redacted] Date 12-6-11 Insp [redacted]
No. 18 Install Arriel 1D1 Engine S/N *9043* Engine T.T. *7400.0* Total Ng *9667.2* Total Np *7845.3* Rental XX Yes ☐ No	Installed serviceable Arriel 1D1 Engine S/N *9043* Reference AS350B2 AMM Chapter 71-11-00 Para 4-2. Name [redacted] Date 12-6-11 Signature [redacted] Cert. No. [redacted] Date 12-6-11 Insp [redacted]
No. 19 Clean the Air Duct.	Cleaned Air Duct ref. Arriel 1D1 MM 71-01-03-110-801-A01. Name [redacted] Date 12-6-11 Signature [redacted] Cert. No. [redacted] Date 12-6-11 Insp [redacted]

SDM-002 Revision: Original

NTSB

Work Cards With Delineated Steps

Sample work card

	DESCRIPTION	MECH	INSP
	D. Check trunnion bearings and drag brace bearing for proper installation and freedom of movement.	X	
3.	INSTALL NOSE LANDING GEAR - REFERENCE AMM	X	X
→	A. Support gear and jack with axle jack to insert trunnion pins in respective spherical bearings (13) on each side of the nose gear wheel well.		
→	B. Jack gear to proper height and tap trunnion pin into place in each trunnion and trunnion support spherical bearing (13) then remove axle jack. **NOTE: NOSE GEAR MUST BE LIFTED INTO POSITION WITH GEAR TRUNNION AXIS PARALLEL TO TRUNNION BEARING AXIS.**		
→	C. Ascertain that the trunnion pin lockpin holes are in alignment with mating holes in trunnion pin lockpins.		

National Transportation Safety Board